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IDENTIFICATION

PRODUCT CODE: AC-E502A-MC
PRODUCT NAME: CZTUTA0 TM03/TU45 UTILITY DRIVER
DATE CREATED: 25 MAY 1978
MAINTAINER: CSS - NASHUA
AUTHOR: J. G. ADAMS/R. J. COLLINS

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1. ABSTRACT

THIS PROGRAM IS INTENDED AS A BRUTE FORCE ROUTINE TO EXECUTE AN OPERATION OR SERIES OF OPERATIONS, CONTINUOUSLY REGARDLESS OF THE RESULTS OF THE OPERATION. BECAUSE OF THE COMPLEXITY OF THE TU45 MAG TAPE SYSTEM AS OPERATED ON THE MASSBUS, IT IS NOT ALWAYS POSSIBLE TO PROVIDE FOR EVERY CONTINGENCY IN THE NORMAL PROGRAMS. THEREFORE THIS UTILITY DRIVER WILL ALLOW AN OPERATOR TO EXECUTE ANYTHING DESIRED IN ANY ORDER. THERE ARE NO ERROR CHECKS OR PRINTOUTS MADE, AND ANY VARIATION FROM PRESET SEQUENCES AND VALUES ARE MADE BY CHANGING THE APPROPRIATE MEMORY LOCATIONS.

2. REQUIREMENTS

2.1 HARDWARE:

- A. ANY PDP-11 PROCESSOR - WITH OR WITHOUT HARDWARE SWITCH REGISTER.
- B. RH MASSBUS CONTROLLER
- C. TMO2/TMO3 MAG TAPE CONTROLLER
- D. AT LEAST ONE (1) TU45 SLAVE

2.2 STORAGE:

THIS PROGRAM REQUIRES AT LEAST 3K OF CORE

3. LOADING PROCEDURE:

USE STANDARD BINARY LOADING PROCEDURE

4. STARTING PROCEDURE

THE PROGRAM IS ALWAYS STARTED AT LOCATION 200 (8)

***LOC. 176 (SWREG) IS DEFINED AS THE SOFTWARE SWITCH REGISTER
(REFER TO SECTION 5 FOR MORE DETAIL)

***IF THE SOFTWARE SWITCH REGISTER IS USED THE DIAGNOSTIC TYPES OUT THE FOLLOWING MESSAGE; SWR=XXXXXX NEW= (REFER TO SECTION 5 FOR OPERATOR OPTIONS)
AT THE START OF THE PROGRAM.

5. CONSOLE SWITCH SETTINGS

IF THE DIAGNOSTIC IS RUN ON A CPU WITHOUT A SWITCH REGISTER THEN A SOFTWARE SWITCH REGISTER IS USED WHICH ALLOWS THE USER THE SAME SWITCH OPTIONS AS THE HARDWARE SWITCH REGISTER. IF THE HARDWARE SWITCH REGISTER DOES NOT EXIST OR IF ONE DOES AND IT CONTAINS ALL ONES (177777) THEN THE SOFTWARE SWITCH REGISTER (LOC. 176) IS USED.

CONTROL:

THIS PROGRAM ALSO SUPPORTS THE DYNAMIC LOADING OF THE SOFTWARE SWITCH REGISTER (LOC. 176) FROM THE TTY. THIS CAN BE ACCOMPLISHED BY DOING THE FOLLOWING:

- 1) TYPE CONTROL G < G>; THIS WILL ALLOW THE TTY TO ENTER DATA INTO LOC. 176 AT SELECTED POINTS WITHIN THE PROGRAM.
- 2) THE MACHINE WILL THEN TYPE: SWR=XXXXXXNEW= (XXXXXX IS THE OCTAL CONTENTS OF THE SOFTWARE SWITCH REGISTER.)
- 3) AFTER THE ''NEW='' HAS BEEN TYPED THEN THE OPERATOR CAN DO ONE OF THE FOLLOWING AT THE TTY:
 - A) TYPE A NUMBER TO BE LOADED INTO LOC. 176 FOLLOWED BY A <CR>. (ONLY NUMBERS BETWEEN 0-7 WILL BE ACCEPTED AND ONLY 6 NUMBERS WILL BE ALLOWED)
IF A <CR> IS THE FIRST KEY DEPRESSED THE SOFTWARE SWITCH REGISTER CONTENTS WILL NOT BE CHANGED.
 - B) IF A CONTROL U < U> IS DEPRESSED THEN THE PROGRAM WILL SEND YOU BACK TO STEP 2.

SW15(100000): 1=STOP AFTER EACH OPERATION

0=PROCEED

SW14(040000): 1=STOP AT THE END OF THE OPERATION SEQUENCE

0=PROCEED

SW13(020000): 1=IGNORE END OF TAPE (EOT)

0=REWIND AT END-OF TAPE (EOT)

5.1 HALT

TO CHANGE THE CONTENTS OF SWREG TYPE < G> BEFORE PRESSING CONTINUE AFTER A HALT.

6. OPERATION

THE PROGRAM OPERATION IS QUITE SIMPLE, BUT DOES REQUIRE THE OPERATOR TO HAVE KNOWLEDGE OF THE TU45 TAPE SYSTEM AS OPERATED ON THE RH MASSBUS CONTROLLER. THE OPERATOR MUST BE ABLE TO DECIDE WHICH SEQUENCE OF OPERATION IS REQUIRED, AND WHAT VALUES TO ASSIGN TO THE VARIOUS PARAMETERS REQUIRED TO EXECUTE THEM. THE OPERATION SEQUENCE IS SET UP BY LOADING A TABLE WITH THE FUNCTION CODES OF THE DESIRED OPERATIONS AND SETTING THE NUMBER OF OPERATIONS IN A COUNTER. THE PROGRAM IS SET UP TO DO A WRITE OF TEN (8) WORDS OF ALL ONES DATA TO SLAVE ZERO (0) ON DRIVE ZERO (0) IN PE (1600 BPI) WITH A NINE TRACK NORMAL DATA FORMAT. THE DATA ADDRESS IS 3000 (8). THE OPERATION SEQUENCE IS SET TO DO A SINGLE WRITE. IF LOADED AND STARTED AT 200 (8) WITH NO CHANGES MADE AND SWITCH 14 AND 15 SET TO A ZERO (0), THIS OPERATION WILL BE EXECUTED CONTINUOUSLY.

THE FOLLOWING IS THE LIST OF PARAMETERS WHICH MAY BE VARIED AND A DESCRIPTION OF EACH ALONG WITH THEIR CORE LOCATION:

PARAMETER	LOCATION	DESCRIPTION
RH ADDRESS	600	ADDRESS OF RH (THE FIRST REGISTER ADDRESS: CS1)
DRIVE NUMBER	700	SET TO SELECT TM02/TM03 NUMBER ADDRESS 0-7
UNIT DESCRIPTION	702	SET SELECTED SLAVE NUMBER (0-7) IN BITS 0,1,2 SELECT PARITY IN BIT 3 (0=ODD 1=EVEN) SELECT DATA FORMAT IN BITS 4,5,6,7 SELECT DENSITY IN BITS 8,9,10
FRAME COUNT	704	SET NUMBER OF FRAMES TO WRITE PER WORD COUNT AND FORMAT IN TWOS' COMPLIMENT
WORD COUNT	706	SET NUMBER OF WORDS TO BE TRANSFERRED IN TWOS' COMPLIMENT
READ ADDRESS	710	SET DESIRED ADDRESS FOR START OF READ BUFFER.
WRITE ADDRESS	712	SET DESIRED ADDRESS FOR START OF WRITE BUFFER.
READY DELAY	714	THIS DELAY VALUE IS USED BY THE PROGRAM TO ESTABLISH A MAXIMUM TIME TO AWAIT THE COMPLETION OF AN OPERATION BEFORE PROCEEDING TO THE NEXT. ** (DEFAULT IS APPROX 435 MS FOR PDP-11/20)**
READY MULTIPLIER	716	IF THE VALUE SET INTO 714 DOES NOT ALLOW ENOUGH TIME, INCREASE THE SIZE OF THE MULTIPLIER. EACH INCREMENT OF THE MULTIPLIER WILL CAUSE THE 714 DELAY TO BE EXECUTED THAT MANY MORE TIMES.

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OPERATION DELAY	720	THIS DELAY IS USED TO ALLOW FOR SOME AMOUNT OF TIME BETWEEN THE EXECUTION OF EACH OPERATION. IT IS LOADED AND USED JUST AS IN THE READY DELAY(714) **(DEFAULT IS APPROX 54 MS FOR PDP-11/20)**
OPER MULTIPLIER	722	THIS IS USED JUST AS THE READY DELAY MULTIPLIER(716)
OPERATION NUMBER	724	THIS IS THE NUMBER OF OPERATIONS TO BE PERFORMED IN A SEQUENCE AND SHOULD REFLECT THE NUMBERS OF OPERATIONS SET INTO THE OPERATION TABLE.
OPERATION TABLE	740-770	THIS TABLE (CONSISTING OF 15 LOCATIONS) IS TO BE LOADED WITH THE FUNCTION CODES FOR EACH OPERATION TO BE PERFORMED IN SEQUENCE. THE NUMBER OF ENTIRES MAY BE FROM ONE (1) TO FIFTEEN (15). MAKE SURE THAT THE NUMBER OF FUNCTION CODES SET IN THE TABLE IS REFLECTED BY THE NUMBER IN LOCATION 724 (OPNUM)

6.1 FUNCTION CODES

20=READ IN PRESET
02=REWIND-OFF LINE
06=REWIND
10=DRIVE CLEAR
26=WRITE TAPE MARK
24=ERASE
30=SPACE FORWARD
32=SPACE REVERSE
50=WRITE CHECK FORWARD
56=WRITE CHECK REVERSE
60=WRITE FORWARD
70=READ FORWARD
76=READ REVERSE

6.2 DATA FORMATS (BIT 7,6,5,4 OF UNIT DESCRIPTION)

14=NINE TRACK NORMAL: 2 FRAMES PER WORD
15=CORE DUMP: 4 FRAMES PER WORD

6.3 DENSITY (BITS 10,9,8 OF UNIT DESCRIPTION)

4=1600 BPI:PE (PE USES ONLY ODD PARITY)
3=800 BPI:NRZI
2=800 BPI:NRZI (TU45 ONLY)
1=556 BPI:NRZI (TU45 ONLY)
0=200 BPI:NRZI (TU45 ONLY)

6.4 PARITY (BIT 3 OF UNIT DESCRIPTION)

1=EVEN PARITY
0=ODD PARITY

6.5 SLAVE SELECT (BITS 2,1,0 OF UNIT DESCRIPTIONS)

SET TO DEVICE SLAVE ADDRESS (0-7)

7. PROGRAM DESCRIPTION

IN ORDER TO MAINTAIN THE CONTINUOUS EXECUTION OF
THE OPERATIONS DESCRIBED THE PROGRAM IS ORGANIZED AS
FOLLOWS:

START
INITIALIZE THE RH
SET UP TAPE PARAMETERS (DENSITY, PARITY, FORMAT: WORD COUNT, FRAME COUNT, BUS ADDRESS)
SELECT DEVICE TO TEST (DRIVE NUMBER, SLAVE NUMBER)
EXECUTE OPERATION (SET FUNCTION AND FROM OP TABLE AND SET GO=1)
AWAIT END OF OPERATION (READY DELAY)
STOP IF SWITCH 15=1
DO OPERATION DELAY (OP DELAY)
STOP IF LAST OPERATION IN SEQUENCE AND SWITCH 14=1
POINT TO NEXT FUNCTION CODE IN OP TABLE
JUMP BACK TO START

7.1 FLOW: START: HOUSEKEEPING
INIT: CLEAR MASSBUS AND TM02/TM03
SET UP: SET UP REQUIRED REGISTERS
EXECUTE: SET FUNCTION AND GO=1
AWAIT END: LOOP ON DRY=1 AS LONG AS ALLOWED BY READY DELAY
STOP: IF SWITCH 15=1
DELAY: PER OP DELAY
END OF RSEQUENCE? IF NOT JUMP TO START
STOP: IF SWITCH 14=1
JUMP TO START RESTART SEQUENCE

7.2 VARIATIONS: THERE ARE TWO VARIATIONS MADE FROM THIS FLOW.
BOTH ARE CAUSED BY A PARTICULAR FUNCTION CODE.
IF A READ REVERSE IS TO BE EXECUTED, THEN THE
BUS ADDRESS IS INCREMENTED BY THE SIZE OF THE
RECORD BECAUSE THE DATA IS LOADED INTO MEMORY
IN REVERSE (I.E: HIGH ADDRESS TO LOW ADDRESS)
THE SECOND VARIATION IS CAUSED BY A SPACE (FORWARD OR REVERSE)
OPERATION AND IT IS THAT THE FRAME COUNTER IS SET TO A -1
SO THAT ONLY ONE (1) RECORD IS SPACED OVER. IF YOU WISH
TO SPACE OVER MORE THAN ONE (1) RECORD, SET LOCATION 1100 (8)
TO THE TWOS' COMPLIMENT OF THE NUMBER OF RECORDS DESIRED.

8. LISTING

311

.LIST BIN,LOC,SEQ

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000001
000002
000003
000004
000005
000006
000007

000046 000046
000046 000170

000176 000176
000176 000000

000200 000200
000200 000167 001110

```
.TITLE TU45 UTILITY DRIVER
:CZTUTAO
:25 MAY 78
:J. G. ADAMS/R. J. COLLINS
:REVISED APRIL ,1976 BY S. CARPENTER
:      1) SUPPORTS SOFTWARE SWITCH REGISTER
:      2) SUPPORTS THE DYNAMIC LOADING OF THE SOFTWARE SWITCH REGISTER
:REVISED APRI 1977 BY J. G. ADAMS

:      1)DOCUMENTATION CHANGES TO REFLECT TM03/TU45 CAPABILITY
.ABS

:CONSOLE SWITCHES

:SW 15=1(100000) STOP ON EACH OPERATION
:      0 CONTINUE
:SW 14=1(040000) STOP AT END OF SEQUENCE
:      0 CONTINUE
:SW 13=1(020000) IGNORE END OF TAPE (EOT)
:      0 REWIND AT END OF TAPE (EOT)

:REGISTER EQUIVES

R0=%0
R1=%1
R2=%2
R3=%3
R4=%4
R5=%5
SP=%6
PC=%7

.=46
RESTART:      170      ;ALLOW RESTART WHEN <LF> IS PRESSED
                  ;DURING CHANGING OF SWREG IF SOFTWARE SWITCH
                  ;REGISTER IS USED.

:SOFTWARE SWITCH REGISTER*****

.=176
SWREG: 0      ;SOFTWARE SWITCH REGISTER

:*****

:THIS PROGRAM SUPPORTS THE SOFTWARE SWITCH REGISTER LOC.176.
:REFER TO SECTION 5 OF DOCUMENT FOR DESCRIPTION

:*****

:STARTING ADDRESS

.=200
JMP      SETUP
```

```
368          000600          .=600
369
370          ;TM02/TM03 REGISTERS
371
372 000600 172440 C1: 172440
373 000602 172442 WC: 172442
374 000604 172444 BA: 172444
375 000606 172446 FC: 172446
376 000610 172450 CS: 172450
377 000612 172452 DS: 172452
378 000614 172454 ER: 172454
379 000616 172456 AS: 172456
380 000620 172460 CC: 172460
381 000622 172462 DB: 172462
382 000624 172464 MR: 172464
383 000626 172466 DT: 172466
384 000630 172470 SN: 172470
385 000632 172472 C2: 172472
386
387          ;PROCESSOR ADDRESSES
388
389 000634 177776 PSW: 177776 ;PROCESSOR STATUS
390 000636 177570 SWR: 177570 ;SWITCH REGISTER
391
392          ;TTY REGISTERS
393
394 000640 177560 TKS: 177560 ;TTY READER STATUS
395 000642 177562 TKB: 177562 ;TTY READ BUFFER
396 000644 177564 TPS: 177564 ;TTY PUNCH STATUS
397 000646 177566 TPB: 177566 ;TTY PUNCH BUFFER
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453          001000          . =1000
454          ; START OF PROGRAM*****
455
456 001000 012706 000500      START:  MOV    #500,SP
457 001004 012777 000340 177622      MOV    #340,@PSW
458
459 001012 016700 177706          MOV    OPNUM,R0          ;SET COUNTER
460 001016 012701 000740          MOV    #OPTBL,R1        ;SET POINTER
461 001022 012777 000040 177560  A:    MOV    #40,@CS          ;INIT
462 001030 016777 177644 177552      MOV    DRVN,@CS         ;DRIVE NUMBER
463 001036 016777 177640 177566      MOV    UDES,@C2        ;UNIT DESCRIPTION
464 001044 016777 177636 177530      MOV    WCNT,@WC        ;WORD COUNT
465 001052 016777 177626 177526      MOV    FCNT,@FC        ;FRAME COUNT
466 001060 012102          MOV    (R1)+,R2        ;SET OP CODE
467 001062 022702 000030          CMP    #30,R2          ;SEE IF SPACE FORWARD
468 001066 001403          BEQ    AA              ;IF SO: BR
469 001070 022702 000032          CMP    #32,R2          ;SEE IF SPACE REVERSE
470 001074 001003          BNE    A0              ;IF NOT: BR
471 001076 012777 177777 177502  AA:   MOV    #-1,@FC          ;SET TO SPACE ONE RECORD
472 001104 022702 000060          A0:   CMP    #60,R2          ;SEE IF READ OP
473 001110 103404          BLO    A1              ;IF SO: BR
474 001112 016777 177574 177464      MOV    WADDR,@BA       ;SET WRITE ADDRESS
475 001120 000413          BR     A3
476 001122 016777 177562 177454  A1:   MOV    RADDR,@BA       ;SET READ ADDRESS
477 001130 022702 000070          CMP    #70,R2          ;SEE IF READ OPERATION
478 001134 001405          BEQ    A3              ;IF SO: BR
479 001136 016703 177542          MOV    FCNT,R3         ;GET FRAME COUNT
480 001142 005403          NEG    R3
481 001144 060377 177434          ADD    R3,@BA          ;SET BUS ADDRESS FOR READ REVERSE
482 001150 052702 000001          A3:   BIS    #1,R2           ;SET GO BIT
483 001154 000240          NOP
484 001156 000240          NOP
485 001160 010277 177414          MOV    R2,@C1          ;START OPERATION
486 001164 000240          NOP
487 001166 000240          NOP
488 001170 016704 177522          MOV    RDYDX,R4        ;SET DELAY MULTIPLIER
489 001174 016703 177514          BO:   MOV    RDYDLY,R3     ;SET READY DELAY
490 001200 032777 000200 177404  B:    BIT    #200,@DS
491 001206 001005          BNE    C               ;IF DRY: BR
492 001210 005303          DEC    R3
493 001212 001372          BNE    B
494 001214 005304          DEC    R4
495 001216 001366          BNE    B0              ;DELAY FOR DRIVE READY
496 001220 000240          NOP
497 001222 005777 177410          C:    TST    @SWR         ;SEE IF STOP ON OPERATION
498 001226 100001          BPL    D               ;IF NOT: BR
499 001230 000000          HALT
500 001232 004767 000302          D:    JSR    PC,CKSWR    ;CHECK FOR CNTL G
501 001236 000240          NOP
502 001240 000240          NOP
503 001242 016704 177454          E0:   MOV    OPDX,R4         ;SET DELAY MULTIPLIER
504 001246 016703 177446          E:    MOV    OPDLY,R3     ;SET OPERATION DELAY
505 001252 005303          DEC    R3
506 001254 001376          BNE    E
507 001256 005304          DEC    R4
508 001260 001372          BNE    E0              ;DELAY BETWEEN OPERATIONS
    
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509 001262 004767 000152      JSR    PC,RWND      ;GO SEE IF REWIND
510 001266 005300              DEC    RO
511 001270 001254              BNE    A            ;IF SEQUENCE NOT DONE: BR
512
513 001272 032777 040000 177336  BIT    #40000,@SWR  ;SEE IF HALT ON SEQUENCE
514 001300 001401              BEQ    1$
515 001302 000000              HALT
516 001304 004767 000230      1$:   JSR    PC,CKSWR  ;CHECK FOR CNTL G
517 001310 000167 177464      JMP    START
518
519                          ;RH REGISTER SETUP*****
520
521 001314 000240      SETUP:  NOP
522 001316 016701 177256      MOV    C1,R1      ;GET ADDRESS OF CS1
523 001322 012700 000015      MOV    #15,RO     ;SET NUMBER OF REGISTERS
524 001326 012702 000602      MOV    #WC,R2     ;GET FIRST ADDRESS
525 001332 062701 000002      SETA:  ADD    #2,R1 ;INCREMENT
526 001336 010122      MOV    R1,(R2)+   ;LOAD ADDRESS
527 001340 005300      DEC    RO         ;SEE IF DONE
528 001342 001373      BNE    SETA       ;IF NOT: BR
529 001344 012706 000500      MOV    #500,SP
530 001350 013746 000006      SUSWR: MOV    @#6,-(SP) ;SAVE VECTORS
531 001354 013746 000004      MOV    @#4,-(SP)
532 001360 012737 001400 000004  MOV    #1$,@#4    ;SET UP FOR TIMEOUT
533 001366 022777 177777 177242  CMP    #-1,@SWR   ;REFERENCE HARDWARE SWITCH REGISTER
534 001374 001402      BEQ    2$
535 001376 000404      BR     3$
536 001400 022626      1$:   CMP    (SP)+,(SP)+ ;ADJUST STACK
537 001402 012767 000176 177226  2$:   MOV    #SWREG,SWR ;POINT TO SOFTWARE SWITCH REG
538 001410 012637 000004      3$:   MOV    (SP)+,@#4   ;RESTORE VECTORS
539 001414 012637 000006      MOV    (SP)+,@#6
540 001420 023727 000636 000176  CMP    @#SWR,#SWREG ;IS SOFTWARE REG USED
541 001426 001002      BNE    GO         ;BRANCH IF NO
542 001430 004767 000156      JSR    PC,CNTLU   ;ALLOW SOFTWARE SWITCH REGISTER TO BE CHANGED
543 001434 000167 177340      GO:   JMP    START     ;ELSE GO START EXECUTION
544
545                          ;REWIND FROM EOT (PER SW13)
546
547 001440 032777 020000 177170  RWND:  BIT    #20000,@SWR ;SEE IF IGNORE EOT
548 001446 001033      BNE    RWNDX      ;IF SO: BR
549 001450 032777 002000 177134  BIT    #2000,@DS  ;SEE IF AT EOT
550 001456 001427      BEQ    RWNDX      ;IF NOT: BR
551 001460 012777 000040 177122  MOV    #40,@CS    ;INIT
552 001466 016777 177206 177114  MOV    DRVN,@CS   ;SET DRIVE NUMBER
553 001474 016777 177202 177130  MOV    UDES,@C2   ;SET SLAVE NUMBER
554 001502 012777 000007 177070  MOV    #7,@C1     ;START REWIND
555 001510 032777 000200 177074  RWNDA: BIT    #200,@DS ;SEE IF DRY
556 001516 001774      BEQ    RWNDA      ;IF NOT: BR
557 001520 032777 020000 177064  RWNDB: BIT    #20000,@DS ;SEE IF PIP RESET
558 001526 001374      BNE    RWNDB      ;IF NOT: BR
559 001530 005726      TST    (SP)+      ;RESET STACK
560 001532 000167 177242      JMP    START     ;RESTART SEQUENCE
561 001536 000207      RWNDX: RTS    PC ;RETURN

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562
563
564      :CKSWR ROUTINE THAT ALLOWS THE LOADING OF LOC.176, SWREG*****
565      :FROM THE TTY AT SELECTED POINTS WITHIN THE PROGRAM*****
566 001540 022767 000176 177070 CKSWR:  CMP      #SWREG,SWR      ;SOFTWARE SWITCH REG PRESENT
567 001546 001041          BNE      OUT          ;NO, GET OUT
568 001550 105777 177064   TSTB     @TKS          ;YES, WAIT FOR
569 001554 100036          BPL      OUT          ;READY, GET CHARACTER
570 001556 017767 177060 177142   MOV      @TKB,TIB     ;AND STRIP OFF
571 001564 042767 177600 177134   BIC      #177600,TIB  ;THE GARBAGE
572 001572 022767 000007 177126   CMP      #7,TIB      ;IS IT A < G>
573 001600 001024          BNE      OUT
574 001602 012704 002512   MOV      #SCNTG,R4
575 001606 004767 000242   JSR      PC,TTOUT
576 001612 012704 002516   CNTLU:  MOV      #MSWR,R4
577 001616 004767 000232   JSR      PC,TTOUT
578 001622 017703 177010   MOV      @SWR,R3
579 001626 004767 000354   JSR      PC,OCPE
580 001632 012704 002525   MOV      #SMNEW,R4
581 001636 004767 000212   JSR      PC,TTOUT
582 001642 005037 000736   CLR      @TEMPST
583 001646 004767 000002   JSR      PC,$READ
584 001652 000207          OUT:    RTS          ;GO READ A LINE
585                                     ;RETURN TO MAIN BODY OF PROGRAM
586 001654 005067 177056   $READ:  CLR      TEMPST
587 001660 012767 000007 177044   MOV      #7,COUNT
588 001666 004767 000546   1$:    JSR      PC,TTIN      ;GO READ A CHARACTER
589 001672 042767 177600 177026   BIC      #177600,TIB  ;STRIP OFF GARBAGE
590 001700 122767 000025 177020   CMPB     #25,TIB     ;IS IT A U?
591 001706 001002          BNE      2$          ;BRANCH IF NOT
592 001710 005726          3$:    TST      (SP)+    ;POP THE STACK
593 001712 000737          BR      CNTLU      ;START OVER
594 001714 122767 000015 177004   2$:    CMPB     #15,TIB  ;IS IT A <CR>?
595 001722 001013          BNE      4$          ;BRANCH IF NOT
596 001724 012767 000200 177002   MOV      #200,RDSW
597 001732 004767 000150   JSR      PC,TCRLF
598 001736 022767 000007 176766   CMP      #7,COUNT
599 001744 001037          BNE      7$          ;ECHO IT WITH <LF>
600 001746 005726          8$:    TST      (SP)+    ;WAS IT FIRST CHARACTER
601 001750 000740          BR      OUT        ;CHANGE SWR IF NOT FIRST ONE
602 001752 122767 000060 176746   4$:    CMPB     #60,TIB  ;POP THE STACK
603 001760 003004          BGT      5$          ;GET OUT
604 001762 122767 000067 176736   CMPB     #67,TIB
605 001770 003005          BGT      6$
606 001772 012704 002535   5$:    MOV      #SQUEST,R4
607 001776 004767 000052   JSR      PC,TTOUT
608 002002 000742          BR      3$          ;START OVER IF NOT LEGAL CHARACTER
609 002004 006367 176726   6$:    ASL      TEMPST
610 002010 006367 176722   ASL      TEMPST
611 002014 006367 176716   ASL      TEMPST
612 002020 142767 000060 176700   BICB     #60,TIB     ;GET NITTY-GRITTY
613 002026 156767 176674 176702   BISB     TIB,TEMPST
614 002034 005367 176672   DEC      COUNT      ;ONLY WANT 6 DIGITS
615 002040 001754          BEQ      5$
616 002042 000711          BR      1$
617 002044 016777 176666 176564   7$:    MOV      TEMPST,@SWR ;CHANGE SWITCH REGISTER CONTENTS

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618 002052 000735          BR      8$
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620
621          ;TTY OUTPUT SUBROUTINE*****
622
623 002054 112467 176650  TTOUT:  MOVB   (R4)+,TOB
624 002060 122767 000043 176642  CMPB   #43,TOB
625 002066 001446          BEQ    TEX
626 002070 122767 000045 176632  CMPB   #45,TOB
627 002076 001403          BEQ    TCRLF
628 002100 004767 000064          JSR    PC,TOG
629 002104 000763          BR     TTOUT
630 002106 112767 000015 176614  TCRLF:  MOVB   #15,TOB
631 002114 004767 000050          JSR    PC,TOG
632 002120 012703 000004          MOV    #4,R3
633 002124 005067 176600  TCRLFA: CLR    TOB
634 002130 004767 000034          JSR    PC,TOG
635 002134 005303          DEC    R3
636 002136 001372          BNE    TCRLFA          ;DO FILLERS
637 002140 112767 000012 176562  MOVB   #12,TOB
638 002146 004767 000016          JSR    PC,TOG
639 002152 105767 176556          TSTB  RDSW
640 002156 100401          BMI   1$
641 002160 000735          BR     TTOUT
642 002162 005067 176546  1$:   CLR    RDSW
643 002166 000406          BR     TEX
644 002170 105777 176450  TOG:  TSTB  @TPS
645 002174 100375          BPL   TOG
646 002176 116777 176526 176442  TEX:  MOVB   TOB,@TPB
647 002204 000207          RTS   PC
648
649          ;OCTAL OUTPUT SUBROUTINE*****
650
651 002206 012767 000001 000222  OCTPE:  MOV    #1,OFL
652 002214 010304          MOV    R3,R4
653 002216 000410          BR     OCTP0
654 002220 005067 000212  OCTP:  CLR    OFL          ;CLEAR FLAG FOR LEADING ZERO
655 002224 010304  OCTPE1: MOV    R3,R4          ;SEE IF NUMBER IS ZERO
656 002226 001004          BNE    OCTP0          ;IF NOT ZERO: BR
657 002230 004767 000162          JSR    PC,OCTPG1      ;ELSE PRINT ZERO
658 002234 000167 000120          JMP    OCTP3          ;SPACE AND EXIT
659 002240 032704 100000  OCTP0: BIT    #100000,R4 ;SEE IF MSD = 1
660 002244 001406          BEQ    OCTP1          ;IF NOT: BR
661 002246 012704 000001          MOV    #1,R4
662 002252 004767 000116          JSR    PC,OCTPG      ;PRINT 1
663 002256 000167 000006          JMP    OCTP2
664 002262 005004  OCTP1: CLR    R4
665 002264 004767 000104          JSR    PC,OCTPG      ;PRINT 0
666 002270 010304  OCTP2: MOV    R3,R4
667 002272 006004          ROR   R4
668 002274 006004          ROR   R4
669 002276 006004          ROR   R4          ;POSITION DIGIT
670 002300 006004          ROR   R4
671 002302 000304          SWAB  R4
672 002304 004767 000064          JSR    PC,OCTPG      ;PRINT DIGIT 2
673 002310 010304          MOV    R3,R4

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674 002312 006004 ROR R4
675 002314 000304 SWAB R4
676 002316 004767 000052 JSR PC,OCTPG ;PRINT DIGIT 3
677 002322 010304 MOV R3,R4
678 002324 006104 ROL R4
679 002326 006104 ROL R4
680 002330 000304 SWAB R4
681 002332 004767 000036 JSR PC,OCTPG ;PRINT DIGIT 4
682 002336 010304 MOV R3,R4
683 002340 006004 ROR R4
684 002342 006004 ROR R4
685 002344 006004 ROR R4
686 002346 004767 000022 JSR PC,OCTPG
687 002352 010304 MOV R3,R4
688 002354 004767 000014 JSR PC,OCTPG ;PRINT DIGIT 5
689 002360 012767 000240 176342 OCTPG3: MOV #240,TOB
690 002366 004767 177576 JSR PC,TOG ;PRINT SPACE
691 002372 000207 RTS PC ;EXIT
692 002374 042704 177770 OCTPG: BIC #177770,R4
693 002400 001004 BNE OCTPG0
694 002402 005767 000030 TST OFL
695 002406 001001 BNE OCTPG0
696 002410 000207 RTS PC
697 002412 005267 000020 OCTPG0: INC OFL
698 002416 052704 000260 OCTPG1: BIS #260,R4
699 002422 010467 176302 MOV R4,TOB
700 002426 004767 177536 JSR PC,TOG
701 002432 010304 MOV R3,R4
702 002434 000207 RTS PC
703 002436 000000 OFL: 0 ;FIRST CHAR FLAG
704
705 ;TTY READ SUBROUTINE*****
706
707 002440 005077 176174 TTIN: CLR @TKS
708 002444 005077 176172 CLR @TKB
709 002450 005067 176252 CLR TIB
710 002454 005277 176160 INC @TKS
711 002460 105777 176154 TTIN1: TSTB @TKS
712 002464 100375 BPL TTIN1
713 002466 017767 176150 176232 MOV @TKB,TIB
714 002474 105777 176144 TTIN2: TSTB @TPS
715 002500 100375 BPL TTIN2
716 002502 116777 176220 176136 MOVB TIB,@TPB
717 002510 000207 RTS PC
718
719 002512 057045 021507 $CNTG: .ASCII /% G#/
720 002516 051445 051127 020075 $MSWR: .ASCII /%SWR= #/
721 002524 043
722 002525 040 047040 053505 $MNEW: .ASCII / NEW= #/
723 002532 020075 043
724 002535 077 021445 $QUEST: .ASCII /?%#/
725 004000
726 000100 .=4000
727 0 .REPT 100
728 0
729 .ENDR
  
```

730	005000	.=5000	
731	000100	.REPT	100
732		177777	
733		.ENDR	
734			
735	000001	.END	

A	001022	DB	000622	OCTP1	002262	RWDX	001536	TPS	000644
AA	001076	DRVN	000700	OCTP2	002270	SETA	001332	TTIN	002440
AS	000616	DS	000612	OCTP3	002360	SETUP	001314	TTIN1	002460
AO	001104	DT	000626	OFL	002436	SN	000630	TTIN2	002474
A1	001122	E	001252	OPDLY	000720	START	001000	TTOUT	002054
A3	001150	ER	000614	OPDX	000722	SUSWR	001350	UDES	000702
B	001200	EO	001246	OPNUM	000724	SWR	000636	WADDR	000712
BA	000604	FC	000606	OPTBL	000740	SWREG	000176	WC	000602
BO	001174	FCNT	000704	OUT	001652	TCRLF	002106	WCNT	000706
C	001222	GO	001434	PSW	000634	TCRLFA	002124	SCNTG	002512
CC	000620	MR	000624	RADDR	000710	TEMPST	000736	SMNEW	002525
CKSWR	001540	OCTP	002220	RDSW	000734	TEX	002204	SMSWR	002516
CNTLU	001612	OCTPE	002206	RDYDLY	000714	TIB	000726	SQUEST	002535
COUNT	000732	OCTPE1	002224	RDYDX	000716	TKB	000642	SREAD	001654
CS	000610	OCTPG	002374	RESTAR	000046	TKS	000640	.	= 005200
C1	000600	OCTPG0	002412	RWDX	001440	TOB	000730		
C2	000632	OCTPG1	002416	RWDA	001510	TOG	002170		
D	001232	OCTP0	002240	RWDB	001520	TPB	000646		

. ABS. 005200 000

ERRORS DETECTED: 0

,CZTUTA.SEQ/SOL CZTUTA.P11
 RUN-TIME: 37.3 SECONDS
 RUN-TIME RATIO: 23/11=2.0
 CORE USED: 14K (28 PAGES)